

CLAIMS:

What is claimed is:

1. A method of treating a patient, comprising:
  - (a) providing a tissue removal system;
  - (b) removing adipose tissue from a patient using the tissue removal system, the adipose tissue having a concentration of stem cells;
  - (c) processing at least a part of the adipose tissue to obtain a concentration of stem cells other than the concentration of stem cells of the adipose tissue before processing; and
  - (d) administering the stem cells to a patient without removing the stem cells from the tissue removal system before being administered to the patient.
2. The method as set forth in claim 1, wherein:
  - the adipose tissue is directed in (b) from the patient into the tissue removal system;
  - the adipose tissue is processed in (c) within the tissue removal system; and
  - the stem cells are administered in (d) from the tissue removal system to the patient.
3. The method as set forth in claim 1, wherein (b) comprises at least one of inserting a cannula into the patient in proximity of the adipose tissue to be removed and aspirating adipose tissue from the patient.
4. The method as set forth in claim 1, further comprising:
  - (e) filtering the adipose tissue removed from the patient to separate adipose tissue from non-adipose tissue.

5. The method as set forth in claim 4, wherein (e) comprises delivering the removed adipose tissue to a container having a plurality of pores sized to retain adipose tissue and to pass non-adipose tissue.
6. The method as set forth in claim 1, wherein (c) comprises: degrading the adipose tissue removed from the patient to degrade the tissue without substantially damaging cells contained within the tissue.
7. The method as set forth in claim 6, wherein (c) comprises mixing the adipose tissue with at least one enzyme that disrupts intercellular contact.
8. The method as set forth in claim 7, wherein the adipose tissue is mixed with an enzyme selected from the group consisting of collagenase, dispase, lipase, liberase H1, and trypsin.
9. The method as set forth in claim 6, wherein the enzyme is removed from the adipose tissue early, relative to an amount of time that the enzyme would otherwise be left on the adipose tissue to fully disaggregate the tissue.
10. The method as set forth in claim 1, wherein (c) comprises separating the stem cells from the removed adipose tissue so that the stem cells are substantially free from mature adipocytes and connective tissue.
11. The method as set forth in claim 10, wherein (c) comprises centrifugation.
12. The method as set forth in claim 11, wherein (c) comprises using a spinning membrane filter.
13. The method as set forth in claim 11, further comprising

(e) resuspending the stem cells after the centrifugation.

14. The method as set forth in claim 1, wherein (c) comprises processing the adipose tissue to obtain a greater concentration of stem cells.

15. The method as set forth in claim 1, wherein (c) includes degrading the at least a part of the adipose tissue to generate the concentration of stem cells, and wherein (d) includes combining the concentration of stem cells with another part of the adipose tissue and administering the combination to the patient.

16. The method as set forth in claim 15, wherein a volume of the at least a part of the adipose tissue differs by more than 25% from a volume of other part of the adipose tissue.

17. The method as set forth in claim 15, wherein a volume of the at least a part of the adipose tissue differs by more than 100% from a volume of other part of the adipose tissue.

18. The method as set forth in claim 15, wherein the degrading is performed with one or more enzymes, which are removed from the at least a part of the adipose tissue early, relative to an amount of time that the enzyme would otherwise be left thereon to fully disaggregate the tissue.

19. The method as set forth in claim 1, wherein (c) is followed by mixing the concentration of stem cells from the at least a part of adipose tissue with another part of the adipose tissue, and wherein (d) comprises administering the mixture to a patient.

20. The method as set forth in claim 19, wherein the degrading is performed with one or more enzymes, which are removed from the at least a part of the adipose tissue

early, relative to an amount of time that the enzyme would otherwise be left thereon to fully disaggregate the tissue.

21. The method as set forth in claim 19, wherein a volume of the at least a part of the adipose tissue differs by more than 50% from a volume of other part of the adipose tissue.

22. The method as set forth in claim 19, wherein a volume of the at least a part of the adipose tissue differs by more than 150% from a volume of other part of the adipose tissue.

23. The method as set forth in claim 1, further comprising:

(e) administering an immunosuppressive agent that inhibits rejection of the stem cells from the patient.

24. The method as set forth in claim 23, wherein (e) comprises administering an immunosuppressive agent selected from a group consisting of: cyclosporin, myophenylate mofetil, rapamicin, anti-thymocyte globulin, and agents that reduce costimulation of B-cells and T-cells of the patient.

25. The method as set forth in claim 1, further comprising

(e) administering a cell differentiation factor to the patient to specify differentiation of the stem cells when administered to the patient.

26. The method as set forth in claim 1, wherein (c) comprises only partially disaggregating the at least a portion of the adipose tissue.

27. The method as set forth in claim 1, wherein (c) comprises processing the adipose tissue into multiple portions of adipose tissue.

28. The method as set forth in claim 27, wherein (c) comprises only partially disaggregating at least one of the multiple portions of adipose tissue.
29. The method as set forth in claim 27, comprising mixing at least two of the portions of adipose tissue together.
30. The method as set forth in claim 27, wherein at least one of the portions of adipose tissue has been processed to form a pellet containing stem cells.
31. The method as set forth in claim 1, wherein (d) comprises administering the stem cells to the patient from which the adipose tissue was removed.
32. The method as set forth in claim 1, further comprising:
- (e) cooling the stem cells obtained from the adipose tissue.
33. The method as set forth in claim 1, further comprising
- (e) removing a portion of the stem cells obtained from the adipose tissue from the tissue removal system; and
  - (f) preserving the portion of stem cells removed from the tissue removal system.
34. The method as set forth in claim 33, wherein (f) comprises cryopreserving the portion of stem cells removed from the system.
35. The method as set forth in claim 1, wherein the stem cells are administered to a patient to treat a disease.

36. The method as set forth in claim 1, wherein the stem cells are administered to a patient to treat a cosmetic feature of the patient.
37. The method as set forth in claim 1, wherein the stem cells are administered to a patient to treat bone-related disorders, diseases, or injuries, adipose related disorders or diseases; liver related diseases, disorders, or injuries, myocardial infarctions, renal diseases or kidney damage; retinal diseases or damage or necrosis; wound healing; skeletal muscle disorders both; cartilage and joint repair; lung injuries; diabetes; intestinal disorders; and nervous system disorders, diseases, or injuries.
38. The method as set forth in claim 1, wherein (b) and (c) are automated.
39. The method as set forth in claim 1, further comprising (e) disposing of portions of the tissue removal system that have contacted body fluids after the stem cells have been administered to the patient.
40. A tissue removal system for treating a patient, comprising:
- (a) a tissue collection container including:
    - (i) a tissue collecting inlet port structured to receive adipose tissue removed from a patient; and
    - (ii) a filter disposed within the container and being structured to retain adipose tissue removed from a patient and to pass non-adipose tissue removed from the patient;
  - (b) a mixing container coupled to the tissue collection container to receive stem cells obtained from the adipose tissue without removal of the stem cells from the tissue removal system, and including an additive port for the administration of at least one additive to mix with the stem cells contained therein; and

- (c) an outlet structured to permit the stem cells in the mixing container to be removed from the tissue collection system for administration to a patient.

41. The system as set forth in claim 40, wherein the tissue collecting inlet port is coupled to a cannula that is inserted into a patient to remove adipose tissue from the patient

42. The system as set forth in claim 40, wherein the tissue collection container comprises an aspiration port structured to be coupled to a suction device.

43. The system as set forth in claim 40, further comprising a cell collection container positioned between the tissue collection container and the mixing container so that the stem cells pass from the tissue collection container to the cell collection container before being passed to the mixing container.

44. The system as set forth in claim 43, wherein the cell collection container includes a cell concentrator that facilitates separation of the stem cells in a suspension from a fluid of the suspension.

45. The system as set forth in claim 43, wherein the cell collection container includes a spinning membrane filter.

46. The system as set forth in claim 43, wherein the cell collection container includes a flexible bag.

47. The system as set forth in claim 43, further comprising another filter structured to pass the stem cells from the cell collection container to the mixing container, and to prevent the passage of material that is larger than at least the stem cells contained therein.

48. The system as set forth in claim 47, wherein the other filter comprises a plurality of pores smaller than about 200  $\mu\text{m}$  in diameter.
49. The system as set forth in claim 47, wherein the other filter comprises a plurality of pores having diameters between about 20  $\mu\text{m}$  and 200  $\mu\text{m}$ .
50. The system as set forth in claim 47, wherein the other filter is spaced apart from the cell collection container.
51. The system as set forth in claim 47, wherein the other filter is a component of the cell collection container.
52. The system as set forth in claim 40, further comprising a tissue retrieval line providing a conduit from the tissue collection container to the mixing container to pass tissue retained in the tissue collection container to the mixing container.
53. The system as set forth in claim 40, further comprising a processing device structured to automate removal and processing of the adipose tissue within the system.
54. The system as set forth in claim 40, wherein the tissue collection container includes a body that retains its form when suction is applied to the container by a suction device.
55. The system as set forth in claim 54, wherein the tissue collection container includes a rigid body.
56. The system as set forth in claim 54, wherein the tissue collection container includes a flexible bag.



57. The system as set forth in claim 40, wherein the first filter includes a plurality of pores ranging in size between about 20  $\mu\text{m}$  and 5 mm.
58. The system as set forth in claim 40, further comprising a temperature control device that adjusts the temperature of the material contained in the tissue collecting container.
59. The system as set forth in claim 58, wherein the temperature control device is a heater.
60. The system as set forth in claim 58, wherein the temperature control device is positioned to adjust the temperature of fluid being delivered to the tissue collection container.
61. The system as set forth in claim 40, wherein the outlet is a component of the mixing container.
62. The system as set forth in claim 40, wherein the outlet is spaced apart from the mixing container.
63. The system as set forth in claim 40, wherein the outlet comprises a fluid impermeable membrane.
64. The system as set forth in claim 40, wherein the tissue collecting container, the mixing container, and the outlet define a closed system that is not open to an external environment.

65. The system as set forth in claim 40, further comprising a tissue administration device coupled to the outlet to deliver stem cells contained in the mixing container to a patient.

66. The system as set forth in claim 40, wherein portions of the tissue removal system that have contacted body fluids are structured to be disposed of after a single use.

67. A composition for administration to a patient, comprising:

- a) a first portion of adipose tissue having a stem cell concentration;
- b) a second portion of adipose tissue having a concentration of stem cells greater than the first portion of adipose tissue.

68. The composition as set forth in claim 67, wherein the first and second portions are mixed together.

69. The composition as set forth in claim 68, wherein the second portion of adipose tissue comprises stem cells substantially free of mature adipocytes and connective tissue.

70. The composition as set forth in claim 69, wherein the amount of stem cells in the second portion is greater than about 0.1% of the total amount of cells present in the second portion.

71. The composition as set forth in claim 70, wherein the amount of stem cells in the second portion is about 0.1% to about 100% of the total amount of cells in the second portion.

72. The composition as set forth in claim 70, wherein the amount of stem cells in the second portion is greater than about 20% of the total amount of cells in the second portion.

73. The composition as set forth in claim 69, wherein a concentration of stem cells of the mixed portion is at least fifty percent greater than the concentration of stem cells of the first portion.

74. The composition as set forth in claim 69, wherein a concentration of stem cells of the mixed portion is at least two times greater than the concentration of stem cells of the first portion.

75. The composition as set forth in claim 69, wherein a concentration of stem cells of the mixed portion is at least three times greater than the concentration of stem cells of the first portion.

76. The composition as set forth in claim 67, further comprising a cell differentiation factor present in an amount to control differentiation of the stem cells.

77. The composition as set forth in claim 67, wherein the second portion includes at least partially dissociated adipose tissue.

78. The composition as set forth in claim 67, wherein the second portion of adipose tissue comprises a combination of at least two separate portions of adipose tissue.

79. The composition as set forth in claim 67, wherein the second portion of adipose tissue has been processed other than by culturing or cryopreserving.

80. A method of treating a patient, comprising:

- a) providing an adipose tissue removal system;
- b) removing adipose tissue from a patient using the adipose tissue removal system, the adipose tissue having a concentration of stem cells; and
- c) processing the adipose tissue to increase the concentration of stem cells in the adipose tissue;
- d) mixing the adipose tissue having the concentrated stem cells with another portion of adipose tissue; and
- e) administering the adipose tissue with the increased concentration of stem cells to a patient.

81. The method as set forth in claim 80, wherein (b) comprises at least one of aspirating adipose tissue from the patient and excising adipose tissue from the patient.

82. The method as set forth in claim 81, wherein (c) further comprises disaggregating the filtered adipose tissue, followed by using a spinning membrane filter.

83. The method as set forth in claim 80, wherein (c) comprises separating the adipose tissue into portions, and increasing the concentration of stem cells in at least one portion of adipose tissue.

84. The method as set forth in claim 83, comprising only partially disaggregating the at least one portion of adipose tissue.

85. The method as set forth in claim 83, wherein (c) further comprises mixing the at least one portion of adipose tissue having an increased concentration of stem cells with a portion of adipose tissue that does not have an increased concentration of stem cells.

86. The method as set forth in claim 85, wherein the at least one portion of adipose tissue having an increased concentration of stem cells is obtained from cryopreserved tissue.
87. The method as set forth in claim 80, wherein the tissue removal system is a closed system, and (c) is performed entirely in the closed system.
88. The method as set forth in claim 80, wherein (b) and (c) are automated.
89. the method as set forth in claim 88, wherein (b), (c), and (d) are automated.
90. The method as set forth in claim 80, wherein a volume of the at least a part of the adipose tissue differs by more than 25% from a volume of other part of the adipose tissue.
91. The method as set forth in claim 80, wherein a volume of the at least a part of the adipose tissue differs by more than 100% from a volume of other part of the adipose tissue.
92. The method as set forth in claim 80, further comprising (f) disposing of portions of the tissue removal system that have contacted body fluids after the stem cells have been administered to the patient.